GE Corporate Research
and Development

Building KW, Room C248
September 7, 1993

DARPA/SISTO
Virginia Square Plaza
3701 N. Fairfax Drive
Arlington, VA 22203-1714

Attn.: Dr. Oscar Firschein

Subject: Quarterly Reports

Reference: Contract #MDA972-91-C-0053 titled "Representation and Recognition with Algebraic Invariants and Geometric Constraint Models".

Please find enclosed one copy of the above-referenced report for the quarter ending May 1993. It is provided to you per Section F-67 of the referenced contract. This report is approved for Public Release - Distribution Unlimited.

Please call if you have further questions.

Regards,

Thomas A. Viola
Contract Administrator
Tel: (518) 387-7850, (FAX -7962)

Enclosures

cc:
1. Defense Technical Information Center
Cameron Station, Attn.: DTIC-FDAC
Alexandria, VA. 22304-6145 (two copies)

2. DARPA/SISTO
Attn.: Edward R. Brown
3701 North Fairfax Drive, 7th Floor
Arlington, VA 22203-1714

[¶ 31,735.10]

REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	9/7/93	Progress (3/1/93-6/1/93)

4. TITLE AND SUBTITLE
Representation & Recognition with Algebraic Invariants & Geometric Constraint Models

5. FUNDING NUMBERS
ARPA ORder No. 8228

Contract No. MDA972-91-C-0053

6. AUTHOR(S)
Dr. Joseph L. Mundy

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
GE - Corporate Research & Development
P. O. Box 8 (K1, 5C39)
Schenectady, NY 12301

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
DARPA / SISTO

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

12b. DISTRIBUTION CODE

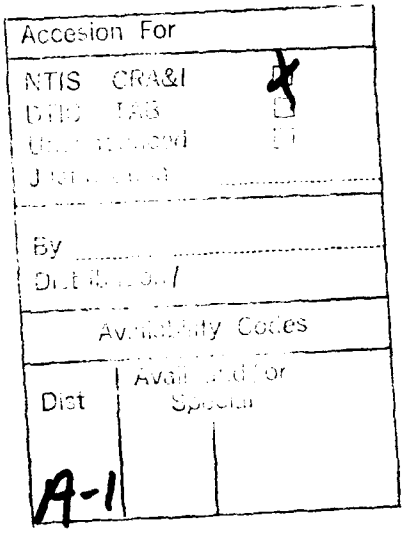
13. ABSTRACT (Maximum 200 words)

This document reports progress on the subject project from 3/1/93 to 6/1/93. A new approach to epipolar calibration has been implemented which provides a coordinate framework for relating features across multiple views. The invariant object recognition system has been successfully demonstrated on RADIUS model board imagery. The approach reported last quarter for the extraction of Euclidean structure has been implemented and initial results are promising.

14. SUBJECT TERMS	15. NUMBER OF PAGES 8
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT

Sponsored by
Advanced Research Projects Agency
Software & Intelligent System Technology Office
Representation and Recognition
With Algebraic Invariants and
Geometric Constraint Models
ARPA ORder NO. 8228
Program Code No. N/A
Contract No. MDA972-91-C-0053
March. 1. 1993 - June 1. 1993



Progress

March 1, 1993 - June 1, 1993
Progress during this period is as follows:

- A new approach to epipolar calibration has been implemented which provides a coordinate framework for relating features across multiple views. We have applied this algorithm to the case of multiple copies of an object in a single view.
- The invariant object recognition system has been successfully demonstrated on RADIUS model board imagery. The system is able to process an arbitrary region of interest in the image containing buildings in the model library. The algorithm runs with reasonable efficiency on a SPARC 10, taking several minutes for a 1024x1024 region of interest.
- The approach reported last time for the extraction of Euclidean structure has been implemented and the initial results are promising. We have been able to recover the area of an object from a single uncalibrated image.

Activities For Next Reporting Period

The work planned for the next reporting period is as follows:

- Explore the use of rotation about the camera center to provide information required to calibrate the internal parameters(orientation) of the camera. This approach can be quite practical since it is easy to rotate a camera approximately around the optical center by standard pan and zoom motions. If the distance to the viewed object is large compared to the size of the camera, then this approach will lead to quite accurate calibration.
- Carry out experiments to validate object recognition using invariants derived from duplicate objects in a single perspective view.
- Continue to develop methods for recovery of Euclidean structure from multiple uncalibrated camera views.

Equipment Purchased

None

Changes in Key Personnel

None

Summary of Information

A paper on the recovery of invariants of 3D polyhedral structures was written jointly with Oxford University. This paper received the best paper award, the Marr Prize, at the fourth International Conference on Computer Vision(ICCV)

Areas of Concern

None

Related Accomplishments

The invariant-based building recognition system was presented at the ARPA IU Workshop. The system was able to automatically register a site model to RADIUS testbed imagery.

GENERAL ELECTRIC COMPANY
CORPORATE RESEARCH & DEVELOPMENT
P.O. BOX 8 (BLDG KW, ROOM C247)
SCHENECTADY, NEW YORK 12301

FUNDS EXPENDITURE REPORT

PROJECT TITLE:	**Representation and Recognition with Algebraic Invariants and Geometric Constraint Models**		
CONTRACT NO:	MDA972-91-C-0053		
PERIOD OF PERFORMANCE	09/91 thru 09/94		
CONTRACT VALUE:	$1,447,606	FUNDS AUTH:	$1,130,346

FOR PERIOD ENDING (05/03/93 - 05/30/93)

A. EXPENDITURES

Current Month	$41.6
Cumulative Total to Date	$847.7

COMMENTS:

G.D. COYLE 06/10/93

GENERAL ELECTRIC COMPANY
CORPORATE RESEARCH & DEVELOPMENT
P.O. BOX 8 (BLDG KW, ROOM C247)
SCHENECTADY, NEW YORK 12301

FUNDS EXPENDITURE REPORT

PROJECT TITLE:	**Representation and Recognition with Algebraic Invariants and Geometric Constraint Models**
CONTRACT NO:	MDA972-91-C-0053
PERIOD OF PERFORMANCE	09/91 thru 09/94
CONTRACT VALUE:	$1,447,606
FUNDS AUTH:	$1,130,346

FOR PERIOD ENDING (03/29/93 - 05/02/93)

A. EXPENDITURES

Current Month	$37.2
Cumulative Total to Date	$806.2

COMMENTS:

G.D. COYLE 05/11/93

GENERAL ELECTRIC COMPANY
CORPORATE RESEARCH & DEVELOPMENT
P.O. BOX 8 (BLDG KW, ROOM C247)
SCHENECTADY, NEW YORK 12301

FUNDS EXPENDITURE REPORT

PROJECT TITLE:	**Representation and Recognition with Algebraic Invariants and Geometric Constraint Models**
CONTRACT NO:	MDA972-91-C-0053
PERIOD OF PERFORMANCE	09/91 thru 09/94
CONTRACT VALUE:	$1,447,606
FUNDS AUTH:	$1,130,346

FOR PERIOD ENDING (03/01/93 - 03/28/93)

A. EXPENDITURES

Current Month	$37.1
Cumulative Total to Date	$769.0

COMMENTS:

G.D. COYLE 04/12/93

GE Corporate Research & Development
Representation & Recognition with Algebraic Invariants & Geometric Constraint Models
Darpa Order No. 8228
Contract No. MDA972-91-C-0053

R&D Status Report
Program Financial Status
Quarter Ending June 1, 1992

	CUMULATIVE TO DATE			AT COMPLETION		
	Planned Expend	Actual Expend	% COMPL	BAC	LRE	REMARKS
Subtotal	1020050	758258	74%	1447606	1447606	
Management Reserve						
Unallocated Resources						
TOTAL	1020050	758258	74%	1447606	1447606	